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APPLICATION OF THE NAPAP EMISSIONS INVENTORIES TO EULERIAN MODELING

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ABSTRACT

This paper presents the schedule for development and evaluation of Eulerian Acid Deposition Models as part of the National Acid Precipitation Assessment Program and discusses the critical need to reduce uncertainties in emissions inventories to provide more reliable modeling results for policy decision making. A strong recommendation is made to expand, improve, and standardize quality assurance procedures for emission inventory development and to incorporate knowledge gained through modeling sensitivity studies in ranking emissions inventory development activities.

INTRODUCTION

One of the primary goals of the National Acid Precipitation Assessment Program (NAPAP) is to develop a comprehensive Regional Acid Deposition Model (RADM) suitable for assessing source-receptor relationships. RADM also forms the scientific basis for development of a series of simpler "engineering models" useful for addressing policy and assessment questions. NAPAP has established the following schedule for development and evaluation of these Eulerian acid deposition models.

February 1986	Preliminary Evaluation of the First Generation Regional Acid Deposition Model (RADM)
October 1986	Testing and Preliminary Assessment of a sulfur deposition Engineering Model

October 1987	Testing and Evaluation of an Advanced Engineering Model Operational For Multiple Species
January 1988	Operational Second Generation RADM
March 1989	Evaluation of Second Generation RADM

NAPAP has planned two major assessments designed to provide decision makers with scientific information necessary for developing acid deposition control strategies. Both the Eulerian models and the emissions inventories will play an important role in the 1987 and 1989 assessments. The 1987 assessment will use an unevaluated set of models for preliminary regulatory analysis, whereas the 1989 assessment will use the evaluated models. Thus a major field study has been proposed for 1987 through early 1988 to collect data necessary for model evaluation. Knowledge of uncertainty both within the model and each associated input data set is required to assess confidence in model predictions. This paper will focus on uncertainty in the emissions data base as related to these Eulerian modeling efforts.

DISCUSSION

From a modeler's viewpoint, uncertainties in emission inventories can be categorized into two types: 1) uncertainties associated with errors or inadequacies in the data base, and 2) uncertainties associated with the representativeness of typical daily emissions patterns for any particular day being modeled. Both the emissions inventory developers and the

modeling groups have begun to address the first type of uncertainty, but from different perspectives. The developers have been primarily concerned with improving and verifying those raw data elements which are used in estimating annual point and county level emissions. Those elements include emissions factors, fuel utilization and quality, production activity, and others. They have also been concerned with improving procedures and data necessary to provide the temporal, spatial, and species resolution required by the Eulerian models. Most of the quality control tests have been performed on these individual data elements and efforts are underway to associate a level of uncertainty with each of the individual elements comprising the final emissions estimates at point, county and grid level.

The modelers, on the other hand, primarily work with the emissions inventories in their most resolved form - hourly gridded emissions. Their quality control tests search mainly for individual grids that appear to be inconsistent with their surroundings, subregions of the modeling domain that appear unexpectedly high or low, VOC species ratios that seem inconsistent with ambient measurement data and unexpected temporal patterns within a subregion. Both the developers and the modelers have compared the NAPAP inventory with other inventories with somewhat different results because of the different frames of reference. Generally, the State totals for individual species favorably agree with other inventories, or discrepancies can be explained by differences in methodology. However, the modelers have found that even when State totals agree there are sometimes significant differences in the spatial or temporal patterns of the gridded emissions, and at times differences in the relative magni-

tudes of the reactive species. This contradiction is often caused by errors in the State emissions which have cancelled out in the State total. Thus it is important for the developers to begin to incorporate into their quality control procedures more analytical tests typically performed by the modelers. In addition, it is important for the modelers to have a better understanding of the quality control procedures and estimates of inherent variability of the individual data elements used in computing emissions.

Uncertainties in emissions introduced by the question of representativeness are crucial for some of the proposed model evaluation studies. The RADM will be examined in an episodic mode; thus, any major deviation of the estimated typical hourly emissions from actual emissions for the particular days being modeled has the potential to influence the model results. Additional burden is then placed on the inventory developers and modelers to ensure that there are no atypical operations in major sources during the modeling periods. For studies of the first generation RADM existing information on the major SO₂ point source emissions will be used to check the representativeness of the NAPAP emissions. Since the field study is still in the planning stages more options are available to reduce uncertainty in the emissions for the second generation RADM studies. Some of the choices include acquisition of data on any anomalous plant operation during the period of interest, installation and operation of continuous emissions monitors (CEM) on major sources, the collection of actual hourly fuel use or production data, improved activity data for area source emissions estimates, etc. All of these options involve signi-

ficant additional cost beyond the production of a typical base year inventory. Therefore, there is a definite requirement to rank data needs to most effectively accommodate improvements in the base inventory as well as the specialized needs of episodic model studies. In response to this need, modeling studies using RADM are currently being performed to gain a better understanding of the sensitivity of the model to uncertainties in emissions. Attention is being given to spatial and temporal variability in all of the major chemical species, and speciation of VOC. These sensitivity studies should provide information useful to optimize the data collection activities and to reduce uncertainties in critical areas.

CONCLUSIONS

In order to confidently use emissions inventories in the development, evaluation, and application of large scale Eulerian models like RADM, it is essential to have an understanding of the quality of the input data bases. Standardized quality assurance and uncertainty estimation procedures must be established by the emission data base developers to provide emissions inventories that are reliable and directly useful for a variety of NAPAP applications. Current modeling sensitivity studies will provide feedback to effectively rank future emissions inventory improvement activities.